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ABSTRACT

For more than 12 years, the Atlantic Science Curriculum Project (ASCP) has attempted to find a feasible path for educational reform in Canada. This search for a voluntary, regionally initiated path to educational reform was necessitated by the absence of substantial federal and provincial and private foundation sources of funding for science curriculum development in Canada. This report is based on research comprising: (1) an examination of the paper trace of the ASCP's history, including correspondence, records of meetings and conversations, contracts and curriculum documents, designs and materials; (2) a review of research and theoretical literature on the questions addressed by the study; and (3) consideration of the written and oral feedback to an initial draft of this paper from the representatives of those constituencies with whom the ASCP has interacted. The paper is organized in four parts. The first part presents a model of educational change advanced in response to a discussion by teachers and curriculum developers involved in the ASCP. The second part considers the relevant interests of students, teachers, authors, researchers, subject matter specialists, policymakers, parents and publishers in relation to curriculum change. The third part examines the relationships between the various participants in the process of curriculum development. The fourth part discusses the process of curriculum development with the ASCP specifically in mind. (CW)

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THE ATLANTIC SCIENCE CURRICULUM PROJECT: IN SEARCH OF A PATH TO EDUCATIONAL REFORM

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A STUDY OF THE ATLANTIC SCIENCE CURRICULUM PROJECT: IN SEARCH OF A PATH TO EDUCATIONAL REFORM

Dedication

This account of the Atlantic Science Curriculum Project is written primarily for those who would like to become involved in the development of curriculum materials for schools as a means of improving education.

Preface

In the context of educational reform, what should be the relationships between teaching, research, educational decision making, professional development and curriculum materials development? Is the prevailing pattern of relationships between teachers, researchers, authors, publishers and policy makers compatible with the improvement of education? Are there feasible alternatives to the prevailing practices?

Answers to these questions have been sought through critical reflection on the experience of the Atlantic Science Curriculum Project (ASCP). It is intended that the results of this study assist those participants in the educational process who wish to contribute to a progressive reform of the educational system. The ASCP is a grass-roots, field based curriculum and professional development project. Its focus of attention from its origins at the Atlantic Institute of Education in 1976 until the present time has been the improvement of science teaching in grades 7, 8 and 9. (For a brief chronology of the ASCP, see Figure 5. An account of the Project's origins and its formative evaluation can be found in McFadden, 1980).

For more than twelve years, the ASCP has attempted to find a feasible path to educational reform in Canada, one that might be undertaken by educators on a local or regional basis with largely voluntary efforts. This search for a voluntary, regionally initiated path to educational reform was necessitated by the absence of substantial federal and provincial government and private foundation sources of funding for science curriculum development in Canada.

In one sense at least, the absence of sources of major funding may have been an advantage. Whereas it might be possible for well funded projects to ignore the interests of some of the partners in the process of educational reform, an unfunded project depends on

goodwill and cooperation with other parties. This study examines the Atlantic Science Curriculum Project's involvement in science curriculum reform efforts in six Canadian provinces and the United States with the objective of disclosing the actual and necessary relationships between the various parties to educational reform.

This report is based on research comprising (1) an examination of the paper trace of the Project's history, including correspondence, records of meetings and conversations, contracts and curriculum documents, designs and materials; (2) a review of research and theoretical literature on the questions addressed by the study and (3) consideration of written and oral feedback to an initial draft of this paper from representatives of those constituencies with whom the ASCP has interacted.

Much of the latter is incorporated in the form of comments which appear at the end of each part of this monograph. These provide contrast and balance in relation to the biases of the author, who is also the Chairman of the ASCP's Board of Directors and who has been the primary organizer of the Project from its inception. The viewpoints of publishers, authors, teachers, teacher educators and educational policy makers are all articulately represented through these comments. Initials within square brackets at the end of a paragraph indicate that a comment on that paragraph is included.

This paper is in four parts. Readers interested in the author's recommendations on how a group of educators who wish to promote curriculum reform might go about this task may refer directly to the final part of this paper.

The paper begins where the first phase of the Atlantic Science Curriculum Project ends, that is at the culmination of a process of constructing a new curriculum and the commencement of the process of introducing it. Having initially set themselves the more modest task of improving upon the existing science curriculum in grades 7, 8 and 9, the teachers and authors who have participated in the Atlantic Science Curriculum Project have struggled to understand the character of what they have achieved and what they face if they want to maintain and go beyond their initial gains. The tenor of the discussion among partisans of the ASCP, particularly teachers using the materials developed by the Project, has been to urge recognition

that the curriculum change which these materials represent is fundamental, that this change can only succeed in the long run if it is supported by corresponding changes in the surrounding educational milieu. The first part of this paper, therefore, presents the model of educational change advanced by the author in response to this discussion. It has been utilized by some teachers as an explanation and guide. It is presented at the outset of this paper to provide a context for reflection on the process of curriculum development. For many, it may also serve as a partisan statement of goals.

The second part of this paper considers the relevant interests of students, teachers, authors, researchers, subject matter specialists, policy makers, parents and publishers in relation to curriculum change. Those engaged in the process of educational reform will want to understand the motives and interests of the various participants. Of course, this analysis is highly speculative, but does benefit from discussion with Project participants.

The third part of this paper examines relationships between the various participants in the process of curriculum development, focussing on the relationships between authors, publishers, teachers and policy makers. This examination relates the experience of the Atlantic Science Curriculum Project to some of the research and theoretical literature on curriculum development. Curriculum scholars who are primarily interested in studying the process of curriculum change may wish to procede directly to this part. For a more complete account of the ASCP's experience, however, the second and fourth parts of this paper should be read as well.

Part I. A Revolutionary Reform of the System of Education

The Atlantic Science Curriculum Project has promoted teaching which assists students to make scientific sense of the natural world (McFadden, 1989). For this purpose, the ASCP has encouraged the teaching of science in its social and technological context. The intended change from a more traditional emphasis on the transmission of scientific information is believed to be a fundamental one. At issue in this and similar efforts to reform the school curriculum is probably not a modest adjustment of the prevailing system of education but a fundamental transformation. This transformation might result from an accumulation of changes in the various aspects and dimensions of the system, none of which alone could likely become stable changes in practice without supporting changes in most of the other aspects and dimensions of the system. This idea is explored below.

T.S.Kuhn's (1970) description of paradigm shifts in science provides a useful metaphor for considering the nature of a possibly fundamental change in the predominant theory and practice of education. Science was recognized by Kuhn to be a social activity in which prevailing theories guide the research work of a community of scientists. Most research and teaching takes place within the interpretive context of the prevailing theories. Individual discrepancies and contradictions with one of the prevailing theories are not in themselves sufficient to cause a redirection in the practical activity of the community. Rather, it is the accumulation of such discrepancies and contradictions which leads to a change in the prevailing theory and only after a debate and a realignment within the community of scientists. Kuhn describes such a change as a paradigm shift.

For purposes of discussion and analysis of education, some of the current divergences and dichotomies within educational theory and practice are presented in two columns (Figures 1, 2 and 3). An attempt is made to represent the more traditional paradigm in education in the left-hand column within the three Figures. The right-hand column, then, may represent the paradigm towards which current reform efforts and school practices are headed; its achievement would likely equate to a revolution in education.

It should be emphasized that actual school systems may be characterized by a combination of traditional and

revolutionary practices. The question to be asked, then, is "which paradigm prevails and how does that affect the practices that are inconsistent with the prevailing paradigm?" It is not suggested here, for example, that any actual school system is characterized only by traditional practices.

Figure 1 depicts four dimensions of change in the educational system. An educational sytem characterized by the right side of the spectrum in each of these dimensions would, it is suggested, be fundamentally different than a system characterized by the left hand side of the spectrum. Figure 2 outlines corresponding changes in the processes of improving curriculum and instruction and Figure 3 maps out corresponding social changes. It is the author's contention that a revolution in education would correspond to a predominance of features in the right hand columns in these three figures. The theories and practices outlined in the left-hand columns probably constitute a self-contained, self-perpetuating system or paradigm. The achievement of any of the conditions described in the right-hand columns is likely supported by the achievement of other conditions described in those columns. Indeed, it is unlikely that any of the new conditions of teaching can be established on a stable, long-term basis without achievement of most of the other conditions.

Dimensions of Change in the Educational System

Of the four dimensions of change in the educational system depicted in Figure 1, there may not in broad terms be much controversy over the identification of the operative goal, management strategies and teaching practices of the new and old educational paradigms. Education for all, democratic schools and the teacher as facilitator and guide to learning are among the slogans of the educational reform movements. There is, however, controversy over what kind of curriculum is required. Many science educators have argued for a Science-Technology-Society (STS) curriculum to replace the prevailing science curriculum. (e.g. Yager, 1984; Bybee, 1984). In a recent paper, the author has argued that such a change confined to science teaching would be insufficient and would in practice displace the goal which largely defines science teaching, namely, helping students make sense of the natural world. Rather, an STS **school** curriculum is required (McFadden, 1989). In other words, the inter-relations between science, technology and society are properly the concern of the entire school curriculum and indeed define the

Figure 1

DIMENSIONS OF CHANGE IN THE EDUCATIONAL SYSTEM

From		To
Operative Goal		
EDUCATION FOR SOME	→	**EDUCATION FOR ALL**
-emphasis on sorting -importance of IQ testing and concept of a universal scale of intelligence -"academic" education for those "capable" of it and vocational education for the rest		-emphasis on education -importance of recognizing different kinds of intellectual activity -general education for all
Curriculum		
A SCHOOL CURRICULUM OF INDEPENDENT "DISCIPLINES"	→	**AN S-T-S SCHOOL CURRICULUM**
-emphasis on language arts and mathematics -separation of theory and practice, hand and brain		-an integration of knowledge and skill development -technology an integrating link throughout
Management Practices		
AUTHORITARIAN SCHOOLS	→	**DEMOCRATIC SCHOOLS**
-emphasis on obedience -top-down administration		-emphasis on participation -collegiality
Teaching Practices		
TEACHER AS SOURCE OF KNOWLEDGE	→	**TEACHER AS FACILITATOR & GUIDE OF LEARNING**
-emphasis on information -emphasis on verification of known truths -teaching = talking -learning = memorizing -student assessment = tests for recall		-emphasis on concepts, ideas, theories, methods -emphasis on organized inquiry -teaching=facilitating and guiding learning -learning=appropriation -tests, practical work and projects given for understanding & skills

Figure 2

EFFECTING CHANGE IN THE EDUCATIONAL SYSTEM

From	To
Curriculum Development	
PIECE-MEAL, STOP-GAP CURRICULUM DEVELOPMENT	**COORDINATED, LONG-TERM CURRICULUM DEVELOPMENT**
-curriculum designs/guide-lines and/or curriculum resource selection = policy	-curriculum design linked with curriculum resource development
-curriculum design and/or curriculum resources untested	-curriculum design and supporting curriculum resources classroom tested & revised until both are satisfactory
In-Service Teacher Education	
SPORADIC, STOP-GAP PROFESSIONAL DEVELOPMENT	**CONTINUING, PLANNED PROFESSIONAL DEVELOPMENT**
-one-day in-service sessions and other ad hoc responses to the need for professional development	-long-term professional development
-in-service "leadership" from unpaid volunteers, who prepare for and plan their work in their "spare" time	-in-service leadership considered a professional (i.e time-off or paid) responsibility of suitably qualified educators
Teacher Recognition and Reward	
INADEQUATE SOCIAL RECOGNITION OF THE TEACHER'S ROLE	**ADEQUATE SOCIAL RECOGNITION OF THE TEACHER'S ROLE**
-salaries below other professionals with equivalent levels of education	-salaries equal other professionals with equivalent levels of education
Pre-Service Teacher Education	
PREPARING SECOND-CLASS PROFESSIONALS	**PREPARING FIRST-CLASS PROFESSIONALS**
-selection of candidates who meet minimum university requirements	-selection of candidates who combine intellectual curiosity and compassion
-preparation which stresses factual knowledge	-stress on such higher intellectual activities as analysis, synthesis, evaluation
-induction into the old teaching paradigm	-induction into the new teaching paradigm

Figure 3

CONDITIONS FOR CHANGE IN THE EDUCATIONAL SYSTEM

From		To
Resources		
INSUFFICIENT SOCIAL WEALTH	→	**SUFFICIENT SOCIAL WEALTH**
-material resources of society are inadequate to support the change		-material resources of society are adequate to support the change
-general education and cultural development of the population is inadequate to provide a sufficient number of teachers able to teach in the new way		-general education and cultural development of the population is adequate to provide a sufficient number of teachers to teach in the new way
Needs		
THE CHANGE IS NOT NEEDED	→	**THE CHANGE IS NEEDED**
-society does not need and cannot utilize the results of the new educational system		-society needs and can utilize the results of the new educational educational system
Policy		
SOCIAL POLICY SUPPORTS THE STATUS QUO	→	**SOCIAL POLICY SUPPORTS THE CHANGE**

character of the new school curriculum. For this, of course, the author has in mind the broadest definitions for science, technology and society, embracing ethics, aesthetics, the fine arts, humanities, physical education, social studies, language arts and mathematics, among other things.

This distinction between an STS science curriculum and an STS school curriculum has been important to the ASCP when assessing its contribution to curriculum reform and trying to map out its plans for the future. The original work of the ASCP emphasized concept development in relevant contexts, including social and technological ones. Later work of the ASCP in response to demands from the Province of Alberta, meant a partial displacement in textbooks for that province of scientific concept learning by units which emphasize technology and, to some extent, social issues. In the context of a reform of social studies, technology education and science education, the new work of the ASCP might contribute to a progressive educational reform. However, its new work for Alberta takes a large step in the direction of displacing the science curriculum with an STS curriculum, which may not on balance actually contribute to a progressive change. It is more likely to delay movement of Alberta junior high science teachers away from a teaching emphasis on content coverage because of a probable preoccupation with covering both the former science content and the new technological and social studies content.

Effecting Change in the Educational System

The traditional practices in curriculum development, in-service teacher education, teacher recognition and reward and pre-service teacher education (summarized in the left-hand column of Figure 2) probably support the maintenance of the status quo. For effecting a revolution in education, the practices summarized in the right-hand column would likely have to prevail.

Unfortunately, curriculum development projects which link curriculum design with curriculum materials development are still the exception rather than the rule. The ASCP was fortunate to be able to forge these links in its initial work for Nova Scotia and New Brunswick. Usually, however, the policy decisions which are intended to guide practice are made at provincial and school board level, whereas the resources that are selected and used are developed by publishers. Correspondence between the policy and resource often extends little further than the

selection and ordering of topics and definitions. This issue is taken up in greater detail in the third part of this paper, when the ASCP's less fortunate experiences in developing materials for Ontario and Alberta are also considered.

The state of teacher education is equally problematic. In particular, without a better-supported system of continuing, planned professional development of teachers, it is not likely that the new paradigm in education could be achieved or maintained. This effort needs the leadership of suitably qualified educators who have time off from teaching or are otherwise supported to carry out this vital responsibility. Also, pre-service teacher education needs to be directed towards putting into schools professionals who combine intellectual curiosity with compassion. Admission procedures and program requirements need to be tailored towards these ends. Finally, pre-service teachers should receive their induction into the profession under the guidance of those who are already working in the new paradigm. The ASCP is active in New Brunswick and Nova Scotia in promoting and assisting with forms of teacher education that support the recent changes in these provinces in the junior high science curriculum.

Another condition for achieving the new goals for education is probably adequate social recognition of the teacher's role, including salaries that are equal to those received by professionals with equivalent levels of education. The notion of the teacher as a second-class professional likely corresponds to the fact-recall teaching paradigm. If schools are wanted that prepare students for full participation in the society of the twenty-first century, more of the best and brightest young people need to be attracted into teaching and kept there by corresponding rewards and working conditions.

Although salaries of Canadian science teachers remain problematic, it may still be easier to attract highly qualified science students into teaching in Canada than in the United States because of the relative absence in Canada of competing employment opportunities for science graduates. Working conditions for Canadian science teachers, however, still leave a great deal to be desired. Among the more obvious needs for fully professional science teaching are private workspaces for teachers, the employment of laboratory technicians and a greater proportion of time for pedagogical research and preparation of classes.

Conditions for Change

The educational system, of course, is not an isolated system whose possibilities can be determined apart from the larger society in which it functions. Social needs, available resources and social policy together largely determine the possibilities of the educational system. Are the material resources of society adequate to support the changes at issue? Is the general education and cultural level of the population adequate to provide a sufficient number of teachers who can teach in the new way? Does society actually need and can it utilize the results of the new educational system? Does social policy support the change to a new educational system?

Recognition that at issue is a fundamental change in the system does not answer the question whether education is indeed on the threshold of a genuine revolution in its guiding theories and predominant practices. The accompanying Figures 1, 2 and 3 do, however, provide criteria for answering this question. For the purposes of this paper, they also provide a description of the context in which curriculum development is thought to take place. For example, the separation of curriculum design (done as educational policy) and curriculum materials development (done by publishers) is thought to be consistent with and supportive of the continuity of the traditional paradigm in education, including among other things, a teaching emphasis on the dispensing of information. Educators who choose to work in this way should recognize that their efforts are more likely to support the maintenance of the status quo, regardless of their personal intentions.

On the other hand, as described in more detail in the later sections of this paper, the Atlantic Science Curriculum Project from the outset adopted procedures and subsequently developed products that are mainly consistent with a fundamentally reformed educational system. The ASCP has sought to support the efforts of teachers to become facilitators and guides to learning rather than information dispensers. The curriculum materials it has developed (various editions of **SciencePlus**, a resource for science students and teachers in grades 7 through 9), are consistent with the new paradigm for education, for example the emphasis in **SciencePlus** on helping students make scientific sense of the natural world, but are not supportive of the old paradigm, for example the absence of vocabulary lists that would facilitate rote teaching

(ASCP, 1986-1990).

Working in a context where the prevailing practices are mainly consistent with and supportive of the status quo, the history of the Atlantic Science Curriculum Project is one of struggle. One of the major gains may have been insights into the process of educational change, the recognition of obstacles in the path of those who would improve education and the identification of means to overcome these obstacles. And, of course, the curriculum materials developed by the ASCP and the Atlantic Science Curriculum Project itself have toeholds within the prevailing educational system, one of many beachheads from which progressive teachers and educational reformers may challenge and ultimately overcome authoritarian, chalk and talk practices. [MD] [AM]

In the next part of this paper, the interests of the various participants and stakeholders in the educational process are considered. As will be evident, all of the participants and stakeholders have interests that would be furthered by educational reform. Moreover, these interests are the overwhelming interests of society. Reformers, however, need also to be aware of the substantial motivation of many of the participants for retaining current practices. Such understanding should help reformers to ally all the essential participants in the process of transforming the educational system.

Comments on Part I

Michael Davis (Vice President, Irwin Publishing; former Atlantic Regional Representative, Harcourt Brace Jovanovich, Canada): On the other hand the new materials may be viewed simply within the context of the old paradigm and not supported in all their potential for change.

Alan Moore (Professor, Nova Scotia Teachers College and Principal Author, ASCP): It was my reading of the situation then and now that teachers were ready for a change, that the paradigm shift of a minor sort was already in progress. Teachers were unhappy with what they were doing, recognized that there had to be better alternatives but could not make the needed adjustments without support of a model or strategy provided by curriculum materials. So the major hurdle in a sense was already overcome - with the identified need for a change.

Part II. The Interests of the Participants in Curriculum Reform

The direct and probably decisive partners in maintaining the status quo in curriculum are probably publishers and curriculum committee members. The latter may represent the interests of curriculum reform, but are basically powerless to achieve it within the context of top-down decision making, particularly given that "curriculum development is about teacher self development" (Stenhouse, 1980). [AN] [AM] [MD] [IS]

For a curriculum reform, however, the power of publishers and curriculum committee members over curriculum would have to be shared with students, teachers, subject matter specialists, educational researchers and the public. The public's role is usually less direct than that of the other participants, but ultimately decisive, exercised primarily through public opinion. More directly, of course, this role is represented within government in Canada by the provincial Ministers of Education and the local school trustees.

Curriculum reformers need to be attentive to the interests of all of the ultimate stakeholders in education. It is not likely that a genuine, fundamental reform could be achieved in any other way. In that sense, fundamental change is achieved through democratic means, whereas the status quo can be maintained from the top.

The interests of the various stakeholders in curriculum reform are considered below. In relation to authors and publishers, some of the experiences of the Atlantic Science Curriculum Project are shared in order to clarify some of these interests.

Students. Even though they appear to be ignored by many authors and publishers, in a genuine curriculum reform, the students are the ultimate clients of new curriculum and curriculum materials, not the adoption committee members nor even the teachers. Pre-adolescent and adolescent students' power over curriculum is exercised primarily through their influence on responsive teachers and parents. On the side of the status quo, it should be recognized that students have an interest in the primacy of their personal, social agendas. Rote learning takes a minimum of time and energy away from pursuits that may often seem to students to be more meaningful than

school-related tasks. On the other hand, students want school to be personally and socially meaningful. Meaningless, unimaginative curriculum and instruction is boring. Student satisfaction with and support for personally and socially meaningful curriculum and instruction can be a powerful impetus to curriculum reform. Improved attention to school-related tasks is the primary way in which students communicate their approval and thereby influence curriculum and instruction.

Teachers. The teachers' power over curriculum planning is exercised primarily through their influence on provincial and local curriculum committees. These committees are usually comprised mainly of teachers. But the teachers' power over curriculum is practically exercised through teaching. Not only is the notion of a teacher-proof curriculum insulting, it is logically fallacious. Above all else, the curriculum resides in the culture, knowledge, understanding and values of teachers.

Teachers, like all people, want to perform their tasks with the minimum expenditure of energy necessary to achieve their objectives, leaving energy for other tasks which are personally meaningful to them. In as much as rote teaching, like rote learning, may seem to require a minimum of energy, the teachers' interest in expending the minimum necessary energy on teaching can be a factor which supports the maintenance of the status quo in education. On the other hand, satisfaction from teaching is largely achieved through recognition and support from students, parents, administrators and other teachers. Teachers' need for a meaningful personal and social existence is a powerful force for the reform of education. If the community, including teachers, believe that the primary goals of teaching cannot be achieved through rote teaching/learning, then the teachers will be the primary driving force for the transformation of an educational system based on information dispensing. [KT] [TL] [AM]

Researchers. Researchers in the field of education, like all those who require an income, have an economic interest in continued employment and promotion. Given the specialized character of their work, its value is most directly established through acceptance by refereed research publications, in other words by its influence on other researchers, and only indirectly, if at all, on educational practice. This factor can be a conservative one, favoring the maintenance of the

status quo in education.

On the other hand, many educators are attracted to research and teaching positions in higher education because of the opportunity these positions afford to assist in the fundamental reform of education. Their research, for example, may explore means to improve student learning, assist the development of new curriculum materials and monitor the success of curriculum reform efforts.

Subject matter specialists. The interests of subject matter specialists in general education are varied. The interest most strongly allied with efforts to improve education is the personal interest of many cultural workers, including scientists and artists, in the level of general humanistic and scientific culture of the population, particularly in relation to the specialist's own field.

Other interests of subject matter specialists have a more complex relationship to public interest. For example, subject matter specialists may require the public's support for their professional activities. Their concern in this respect can have both positive and harmful affects on school curriculum. On the negative side, influence which is out of proportion to the actual role of a given profession in society can lead to an imbalance in school curriculum. Such pressures can also lead to a curriculum that tends to misrepresent the world and to develop passive, uncritical citizens. Moreover, a curriculum which serves educational goals must be more than a collection of topics and subjects representing special interests. On the positive side, a concern for public support can be a cause of the professional's efforts to help adjust school curriculum so that it changes with changes in society's needs.

Among subject matter specialists, it is primarily from college and university teachers that a strong interest in elementary and secondary education is taken. This interest, of course, reflects the fact that the students at tertiary institutions are mainly the graduates of elementary and secondary ones. College and university teachers working within the information dispensing paradigm for education may want their incoming students to be able to recall and regurgitate in acceptable prose the facts, opinions and problem solutions that constitute the content of traditional first year university courses. This makes the job of first year teaching easier, leaving the college and

university teacher more time and energy for research and senior level teaching. On the other hand, to the extent that college and university teaching examines for understanding and evaluative skills, the college and university level teachers' interest in elementary and secondary education can be an aid to educational reform.

Taking into account the relevant interests of subject matter specialists, the process of curriculum development likely must include their participation if the school is to fulfil its social obligation to prepare young people for contributing to society. The alternatives of either ignoring subject matter specialists or ceding to them the ultimate control over curriculum development probably in the final analysis serve to maintain the primacy of an information dispensing function for education. It is likely that priority for an educative function for schools can only be achieved through their participation on the basis of equality with representatives of the other interested parties. [TL]

Policy makers. Those in a position to formulate public policy in education (including elected officials and the civil servants who advise them) can easily imagine they have more power to effect change than they actually do. The manufacture of artifacts, including school structures and curriculum documents, can be commanded; curriculum change probably cannot. From the Minister of Education to local curriculum committee members, real power to change educational practice is probably limited primarily to providing leadership.

Curriculum reformers elected or appointed to positions of responsibility for formulating public policy in education can likely only effectively serve the cause of educational reform if they act within the bounds of their real power. Indeed, authoritarian methods probably serve primarily the maintenance of the status quo and reflect a lack of conviction in either the need or the possibility for educational reform.

Because of the inertia of any system, the interest which a policy maker, including a reformer, may have in personal power and position likely ultimately serves the maintenance of the status quo. On the other hand, the interest of the policy maker in making a meaningful contribution to the development of society can support the fundamental transformation of the educational system, if that is in fact needed by society.

Parents. Of all constituents of the adult community, parents and grandparents have the strongest interest in elementary and secondary education. Moreover, they constitute a majority of the adult community. In a democratically functioning society they have the ultimate power over public education.

Parents have a principal interest in the preparation of their offspring for economic independence. To the extent that the prospects of young people for gainful employment are enhanced by their passivity, their uncritical obedience to authority and their demonstrated ability to parrot the views of a ruling elite, parents may want to support education which produces these results. [KT] [AM]

On the other hand, society's economic and social need for imaginative and creative problem solvers is mirrored in the interest parents have in an educational system which prepares their children for a role in such a society. If it is true that human society cannot successfully cope with the results of its own scientific and technological advance without an educational system that goes beyond a focus on the recall of information, then parents are bound to be the a major ally of the reformers and parenthood a direct impetus to a transformation of the educational system.

Authors. If a change in the content and methods of instruction requires support from published curriculum materials, then the interests of authors and publishers need to be considered. The motives of authors are varied and not necessarily allied with educational reform. In particular, the writing of curriculum materials can be a supplementary, although usually modest source of income for authors. Prior to the institutionalization of a transformed educational system there is probably greater financial return to those authors who are involved in writing traditional materials than there is for those authors attempting to support a reform. It is simply easier to support an information dispensing function for education than a more truly educative one. So long as the majority of educators are satisfied with curriculum materials which support information dispensing, it will be more profitable to write and publish such material. Hence, when income or number of books sold in relation to effort is a major motive, authors are more likely at the present time to want to work on traditional materials.

The ASCP's experience in this respect is illustrative.

The principal authors of **SciencePlus** have expended on average a person-year of professional effort on each of the units they have developed. Thus, in the development of thirty units, a total of over thirty person years of professional effort by the author team was required. The total value of the authors' time invested in the research and writing of the various editions of **SciencePlus** rivals the publisher's investment. The royalty return to the authors, however, is no more than the traditional ten percent of net sales and even this amount is largely needed by the authors to maintain the Atlantic Science Curriculum Project, including the conduct of further research and development. By way of contrast, authors working on the more traditional textbooks which compete with **SciencePlus** have apparently spent between one and two months on each chapter.

Aside from a possible interest in financial reward, most authors have an interest in professional recognition. Depending on the ethical values of the professional community in which they work, this interest might in some cases be a motive for writing materials that contribute to educational reform. However, there are so few school textbooks that any student or parent would voluntarily purchase and read, the actual status of textbook writing is probably very low among critical people. In any case, there are no publicly established forms of recognizing such contributions and thus motivating authors to make them.

Neither an interest in recognition nor financial reward seems to explain why eight principal authors might have contributed over thirty person-years of professional effort during the past decade to the research and writing of **SciencePlus**. It is easier to explain, however, why the Atlantic Science Curriculum Project has not so far been particularly successful in attracting other educators to join it in authoring new materials or to imitate its initiative. Hopefully, if the new educational paradigm becomes the predominant one, there will then be recognition and reward for authorship sufficient to attract those able and willing to make the necessary effort. The period of transition, however, is problematic, and may require major public investment in curriculum development, as is now occuring once again in the United States. [AN] [MS] [AN] [AM]

Publishers. In a critical study of the culture and commerce of the textbook, Michael Apple (1986) observed that "the industry remains perilously poised between

the requirements and constraints of commerce and the responsibilities and obligations that it must bear as a prime guardian of the symbolic culture of the nation." In particular, "those firms that are more commercial, that are oriented to rapid turnover, quick obsolescence, and to the minimization of risks are following a strategy for the accumulation of financial capital... those firms whose goal is to maximize the accumulation of symbolic capital operate in such a way that their time perspective is longer. Immediate profit is less important. Higher risks may be taken and experimental content and form will find greater acceptance" (p.87-88). [DF] [AN]

The latter interest of the publishing industry is more closely allied with the possibilities for educational reform. However, it may be very difficult, if not impossible, for educators to find commercial publishers today who have an interest in long term investments in relation to school textbook publication. Many observers have noted that increased concentration within the publishing industry and other factors have led to a propensity to minimize risks (Apple, 1986; Renz, 1984; Thompson, 1984). As Apple pointed out, "many publishers now prefer to expend most of their efforts on a smaller selection of 'carefully chosen products'". (p.92)

When the Atlantic Science Curriculum Project negotiated a contract in 1984 with a publisher (Academic Press,Canada, a subsidiary of Harcourt Brace Jovanovich) whose activities in Canada at that time were on a relatively small scale, a longer term investment perspective guided the discussions and ultimately the contract. The authors, for example, were able to retain copyright and the right to approve the conditions of sub-contracts for foreign publication. However, when this small scale operation came under common management with one of the larger publishing operations in Canada (Holt, Rinehart and Winston, Canada), considerable pressure was exerted on the ASCP to constructively waive the copyright provisions of the contract, permitting the publisher to assign writers and otherwise take charge of new editions of **SciencePlus**. [MD]

Although the original contract remains in force, the publisher might not sign a similar contract today, a circumstance that is not likely to change unless it ultimately makes a significantly greater rate of profit on **SciencePlus** than it does on the more profitable of its other titles, sufficient to compensate for the cost

of tieing up capital for a longer period of time.

Furthermore, it is not evident from the ASCP's experience that an interest in "symbolic capital" today operates as a major factor in the realm of school textbook publishing. For example, in spite of strong expressions of interest from two of the largest adoption states in the United States and the encouragement and willingness of a large team of influential and highly competent U.S. science educators to support such an effort, including many leading figures within the U.S. National Science Teachers Association, the United States parent company of ASCP's Canadian publisher decided against involvement in a United States edition, in part perhaps because they had a competing program. [AN]

The perspective of the ASCP's publisher is not unique. With its permission, the ASCP has discussed the possibility of a publishing agreement with three other U.S. publishers, so far to no avail. As the chief executive officer of one of the major publishing firms in the United States argued, it is not good business to be ahead of the market. When the author countered with the observation that a curriculum revolution would have to take place first before the publishing industry would support it with materials and asked how such a revolution could take place without such support, he responded, "Yes, that is a dilemma."

The relationships between the various partners in curriculum development is considered in greater detail below. Assuming that a curriculum development project can represent the reform interests of students, teachers, educational researchers, subject matter specialists and parents, the following treatment focusses on the relationships between such a curriculum development project and publishers and policy makers. The practical examples considered are the relationships between the Atlantic Science Curriculum Project, two different publishing houses and several Canadian provincial departments of education.

Comments on Part II

Anonymous (Publishing company executive): In Ontario teachers buy texts from a selection of resources. Traditionally their purchasing decisions have been very conservative. Who controls this situation?

Alan Moore (Professor, Nova Scotia Teachers College and Principal Author, ASCP): Curriculum committee members are the creation of the Department of Education or more directly, the Consultant of Science of the province. The status quo is maintained by a system that dictates that curriculum objectives and content be established by such a committee. The committee is provided with the impossible task of establishing curriculum within the framework of a philosophical statement...

Reform is not entirely blocked by such committees. In the Alberta example, the committee under Bernie [Galbreath - CM] was able to initiate change in some goals of Junior High Science. Admittedly, they were not entirely successful and the Wiley program may have missed the boat in terms of providing a philosophy and approach to learning, but the committee did develop a rationale and strategy for incorporating technology and societal issues into their program. They were fortunate to have SciencePlus as a model for their scope and sequence and for developing their philosophical statements.

Michael Davis (Vice President, Irwin Publishing): Publishers are often interested in a change in the status quo as it provides new opportunities. Obviously, however, the definition of "status quo" and the degree of change are important factors. A radical shift in the process can be unsettling.

Ian Strachan (Teacher, Robert Warren School, Calgary and Developmental Consultant, ASCP): This statement [linking curriculum development and professional development - CM] led me to wonder why many teachers are worried about a new curriculum. The answer seems to be centred around the idea that to teach a new curriculum requires a quantum leap in a teacher's self development which of course requires a lot of time and energy - neither of which the government seems willing to acknowledge nor compensate. We are now into our fifth month of new curriculum and I don't think I've ever worked as hard. The incredible amount of planning within a department, the testing of new materials, the creation of new viable and reliable exams, and the workshops all add to a teacher's workload. No wonder that teachers are concerned when a new curriculum comes

in!

Kenneth Tobin (Professor of Education, Florida State University): I am not convinced [that rote teaching requires a minimum of energy]....I prefer an interpretation [of teaching practice -CM] based on metaphors, beliefs, values, images.

Truman Layton (Teacher and former Science Consultant, Nova Scotia Department of Education): I have never found rote memorizing an easy way to teach junior high kids. I nearly lost my head when I was teaching in Sackville because my tests required thinking rather than memorizing. Parents were outraged and told me - because the kids couldn't memorize their way to a 95+. I didn't meet those enlightened parents you refer to. One of the parents was a Ph.D. oceanographer who wanted his son to do grade 11 chemistry in grade 9.

Alan Moore: Teachers want to be as effective as possible - but need an adequate model for teaching and learning to do so.

Truman Layton: I suspect that subject specialists are the most conservative group of all - strong on content, ignorant of method, level of understanding with age, the need to think about science, etc.

Ken Tobin: And don't forget the culture in which they [parents] were educated continues...

Alan Moore: I suspect that parents and in fact most of those who passed through the system examine changes in curriculum in light of their experiences. The paradigm with which they are familiar may be memorization and regurgitation and they judge other paradigms against this.

Anonymous publishing executive: Very few authors make <u>significant</u> income when you compare it to their salaries. <u>Most</u> authors who approach publishers want to do something "innovative". The problem is that the market won't accept it.

Muriel Smyth (Teacher, retired, Fairview Junior High School and Principal Author, ASCP): Ours is a unique group (or group of unique individuals) with qualities not easily duplicated, for whom the goals of fame and/or fortune would not have been enough to ensure the dedication required over a period of fourteen years....

A junior high science teacher (along with teachers in general, probably) tends to feel powerless to effect

change. One reason for my hanging on through "thick and thin" all these years was that I saw a chance for teachers to put experience and ideas to use in a way that would help a lot of people. Teachers often feel isolated, -- this offered sharing that could lessen that feeling as well.

Anonymous publishing executive: I would have to say that ASCP is very unique; unique to Canada and possibly the world. I believe that its success is not because the group followed a "strategic" plan as outlined in the paper, but because of (1) the people involved and (2) the quality of the material. I am not saying that this supersedes the recommendations in the paper I just feel that at a "grass roots level" these are really the two "success factors."

Alan Moore: The number of person years needed to produce a unit is a powerful argument against other authors joining the project. However, that said, other circumstances have discouraged such collaboration, including short time frames for getting the job done and even lack of confidence on our part that others could produce quality material in the time span.

David Francis (Lanark House Communications, Toronto; former Senior Editor at Harcourt Brace Jovanovich, Canada): I am not sure whether planned obsolescence plays much of a role in Canadian educational publishing. After all, why encourage a province to reconsider an adoption when you are still making a fat margin on reprints? Planned obsolescence is common in college and university textbook publishing, however.

Anonymous publishing executive: There are many differences between Canadian and American publishers. Because we are owned by American parent companies our objectives are set by or with the parent company. These financial objectives are our lifeline. If we didn't meet these objectives there can be dire consequences.

Michael Davis: Academic Press Canada...would have been best categorized as a general house of medium size attempting to develop a more vigorous school publishing program. Its perception of the ASCP was that it was innovative but saleable. Otherwise it would not have taken the plunge.

Anonymous publishing executive: My guess is that the reason HBJ US did not pick up your program was because they had a competing program.

Part III. Relationships Between Authors, Publishers and Policy Makers

Apple (1986) concludes his analysis of the culture and commerce of the textbook with the proposal that "what is required now is a long-term and theoretically and politically grounded ethnographic investigation that follows a curriculum artifact such as a textbook from its writing to its selling (and then to its use)" (p.104). Although the writing of the several editions of **SciencePlus** was in many respects an atypical example of curriculum development, the struggle which the authors waged to maintain editorial control is very instructive about what likely happens in more typical cases. Similarly informative are the difficulties which the ASCP has encountered in the spheres of curriculum dissemination and implementation, where traditional publisher marketting practices and department of education adoption and implementation procedures are significant factors.

Authorship. Typically, publishers own the copyright to school textbooks. In a review of the legal aspects of publishing, Sarna (1980) observed that assigning copyright to the Publisher appears to be equivalent to selling the work to the Publisher. "...Since the employer is the owner of the copyright, he is at liberty to make changes necessary to render the manuscript fit for publication subject to certain rights of the author..." (p.16) [TL]

In 1978 McGraw Hill Ryerson proposed its standard contract to the Atlantic Science Curriculum Project. This proposal included assignment by the author of world copyright to McGraw Hill Ryerson, author agreement to revise the work as required by the publisher and subsidiary rights assigned to the publisher. One feature of this standard contract that may not have been typical was the proposed right of the author "to pass upon" editorial changes made by the publisher.

At the time, alarmed by some of the implications of the proposed contract, the author recommended to his colleagues that the ASCP insist that (1) assignment to the publisher of "the right to publish" be substituted for "world copyright" and the clause, "world copyright ... is to be retained by the author, including the right to make revisions and to have future editions published", be added; (2) the decision about when and whether to revise the work be left to the author; (3) the Publisher have the right "to recommend to the

author" editorial changes in place of the provision in MHR's proposal for the author's right to "pass upon" changes made by the Publisher and (4) subsidiary rights be assigned to the authors, not the Publisher.

In the end, the ASCP agreed with McGraw Hill Ryerson to assign world copyright to the publisher, "registered in the name of the author", revise the work when requested by the Publisher and to give the publisher subsidiary rights. It did, however, extract agreement that the publisher's right to make editorial changes be restricted to recommending changes.

It is probably fortunate for the ASCP that its contract with McGraw Hill Ryerson was cancelled by the publisher two years later because of the failure of the authors to meet manuscript deadlines. In the first place, it was very soon evident that more than two years would be required to develop satisfactory materials for a three year sequence of textbooks and supporting teachers' resource books, particularly given that there was no adequate model for the kind of textbook material the ASCP was developing. Furthermore, the ASCP's confidence in the agreement with McGraw Hill Ryerson had been based on a coincidence in views between the ASCP and the editor who had negotiated the agreement on behalf of the publisher. Within a year that editor had moved to another publishing company and with him went a marketting and editorial perspective that was consonant with the goals of the Project. It is likely a good thing for both parties that the provisions of the contract in relation to editorial control, revised editions and subsidiary rights (which included sub-contracting for editions outside Canada and for editions in languages other than English) were not put to a test.

By the spring of 1983, the ASCP had completed the drafts of 12 of the 19 units it planned for a three year sequence (grades 7, 8 and 9) and had successfully conducted developmental trials of nine of these units. At that time the ASCP entered into preliminary negotiations with several publishers. It sought up-front funding for extensive field testing, editing, photo research, illustration and the development of career guidance materials. The best offer came from Academic Press (later renamed Harcourt Brace Jovanovich, Canada), which did not offer direct funding, but which did agree to have the required, extensive photo research and illustration done at its expense, to assign a Nova Scotia based editor to assist ASCP's author-in-chief and to make its Atlantic

regional representative available to provide back-up managerial assistance to ASCP's project director. It also agreed to give the ASCP full editorial control, including the retention of world copyright. In the meantime, the ASCP obtained funding from the Secretary of State, Canada, for the research and development of a career guidance feature, "Science in Action", and subsequently for research and development of a student assessment strategy consonant with the instructional goals of the Project. Altogether, the ASCP obtained more support than it had initially sought. [MD]

The April 1985 contract between the University of New Brunswick (which represented the ASCP), and Harcourt Brace Jovanovich, Canada, included provision that the publisher register copyright in the name of the author, that the author agree to revise the work when required and that the author be consulted on and approve the conditions of all agreements concluded under the terms of a clause on "additional rights" which pertains to editions published outside of Canada, among other things.

New editions. Subsequently, Harcourt Brace Jovanovich, Canada, then a relatively small operation, merged with Holt Rinehart Winston, Canada, a much larger Canadian publishing house. With this merger came a change in senior management and in apparent policy with respect to new editions and marketting of **SciencePlus** outside the Atlantic Provinces. The three people who had negotiated the contract with ASCP (HBJC's vice-president for school publishing, its senior editor, and its Atlantic representative) had moved to other publishing houses. Whereas these former representatives of the publisher shared the ASCP's view that the arrangement with the ASCP should not be the more usual kind of publishing project, but one that would require a longer-term perspective, one in which the publisher's role in the development and marketting of adapted editions outside the Atlantic Provinces would be linked with the Project's role in expanding its author and implementation support team into these other provinces, the new management saw future editions as more typical publisher controlled initiatives. [DF] [MD] [DF]

This emerging difference in perception led to a meeting with the publisher at the end of May 1986 to which the ASCP invited representatives of the various stakeholders in the Project so that they could clarify their interests and concerns. These "stakeholders" included the teachers' organizations and provincial

departments of education in Nova Scotia and New Brunswick, the supporting universities and scientific organizations in the region and the Secretary of State, Canada, all of whom supported the ASCP in various ways. The minutes of that meeting record that "little progress was made at the meeting on specific proposals for cooperation in dissemination and marketting."

Shortly after publication of **SciencePlus** 1 in 1986, the editor at HBJC who had managerial responsibility for day to day working relationships with the ASCP also left for another publisher. A period of strained relations between the senior management at HBJC and the ASCP ensued.

In relation to some of the key differences which emerged between the publisher and the ASCP, the legal advice obtained by the University of New Brunswick on behalf of the ASCP included the warning to the authors not to allow the provisions of the contract "to be constructively waived". Among the issues around which differences emerged were the following:

(1) The ASCP's submission of title page credits for **SciencePlus** 1 was altered by the omission of reference to the Atlantic Science Curriculum Project, leaving the impression of a typical relationship between author and publisher in which the authors are essentially employees of the publisher. Although this omission was corrected in later books of the Atlantic Edition and in subsequent, new editions, it remains in later, otherwise corrected printings of the first book. The outside back cover of each of the published textbooks includes a list of the names of the principal writers, but nowhere on the cover or spine is there mention of the Atlantic Science Curriculum Project as the author.

(2) A largely unintelligible preface written at the publishing house was inserted in **SciencePlus** 1 without consultation with the ASCP. After objections from the ASCP, this preface, however, was replaced in the second printing by one written by the ASCP. Also in the first book, gremlins in the publishing house took considerable liberty in last minute rewriting of text without approval from the authors, in the process misinterpreting the pedagogical intent and the science. Such practice is probably standard when the publisher owns the copyright. However, it was not repeated again in the publication of **SciencePlus** although errors did continue to creep into the books when the authors were not always given the opportunity to check that text and illustration matched.

(3) At a meeting between publisher and author in

August 1986 at which the above issues were discussed, the publisher announced its intention to appoint writers for subsequent editions of **SciencePlus**. The rights of author and publisher in this respect were in heated dispute for the next several months, stalling work on an Ontario Edition. Ultimately, the differences were resolved under the terms of the existing contract by a request to the ASCP in the spring of 1987 that it develop a new edition that would meet the Ontario Ministry of Education guidelines for science in grades 7 and 8. However, by that time it proved too late for the ASCP to engage and develop an Ontario author team to assist. The ASCP was left with less than six months to write, field test and revise three new units in order to be competitive under the terms of Ontario's new guidelines, which were to go into effect by September 1988. The publisher did assist in supporting the travel and communication costs of a short, but intense working relationship between the ASCP and some very competent, experienced teachers in Ontario.

Credits. According to an account by Sharp (1972), copyright law recognizes the right of the author to claim credit for the work that he or she has authored. It should not be assumed, however, that those listed in school textbooks are necessarily the actual authors of all or most of the material in the text, particularly when the copyright is held by the publisher. The actual authors may include salaried staff of the publishing houses and unacknowledged writers.

Correspondence to the ASCP Board of Directors in November 1986 from the then President of Harcourt Brace Jovanovich, Canada is enlightening about a publisher's point a view on the issue of credits. The ASCP was asked to defer on the content of "front matter" for the Ontario and subsequent new editions of **SciencePlus** on the basis that "such matters are heavily involved in the marketting function assigned to the Publisher." Later, as Managing Director of Harcourt Brace Jovanovich Group (Australia), the former President of HBJC expressed the wish "to use various pieces of the SCIENCE PLUS text materials" in exchange for royalty payments but "probably without acknowledgement." In this connection he implored the ASCP "not to write to anyone in Australia - it will surely kill any arrangement if your do." The Ontario Royal Commission on book publishing had already noted (1973) that the transfer of material from one jurisdiction to another was standard procedure for multinational publishers and presumably a strong advantage they have over smaller,

local publishers.

In a similar vein, Lorimer (1984) has noted the widespread use by publishers of "star consultants", that is people with recognizable names who give credibility to a publisher initiated and controlled project, but who themselves may contribute very little to the actual materials and who may exercise no actual control over the quality of these materials.

Aside from the book covers and the instance mentioned above in connection with one of the title pages, HBJC has otherwise in practice been scrupulous about including the credits and acknowledgements as asked by the ASCP and in the manner requested. In view of the fact that some of their competitors have more or less successfully used traditional practices to give competing materials initial credibility that may not be warranted by the materials themselves, Harcourt Brace Jovanovich, Canada's concern about not having this marketting tool at their disposal is understandable. Ultimately, the answer to the problem of misleading representation of actual authorship is a more critical response by the educators making purchasing decisions and the development of a professional code of ethics among textbook writers and consultants, who should not permit their names to be used in such a way that the actual authority and responsibility for published material is misrepresented.

Managed texts. The Atlantic Science Curriculum Project's experience with publishers in relation to the issues of authorship, new editions and credits may reflect a trend in Canadian school textbook publishing towards "managed texts", a phenomenon that is already characteristic of United States school textbook publishing. Apple (1986) describes managed texts as "books without formal authors", "ghost-written under conditions of stringent cost controls, geared to what will sell and not necessarily to what it is most important to know" (p.96).

The responsibility for this state of affairs ultimately rests with those educators who make curriculum policy and textbook adoption decisions. They have inadvertently created conditions which apparently make "managed texts" the more profitable ones. Since publishing houses are required to make profits for their owners in order to stay in business, it is up to educational policy makers (who are, in essence, the educational publishers' clients) to ensure that the profitability of textbook publishing matches the

quality of the materials published. [DF]

The Atlantic Science Curriculum Project's experience in attempting to meet the requirements of the Provinces of Nova Scotia, New Brunswick, Ontario and Alberta is instructive in relation to the issue of managed texts. In connection with the Atlantic Edition of **SciencePlus**, developed for use in the Atlantic Provinces, the ASCP took as long as it needed to develop materials designed to assist teachers achieve realizable goals for science teaching. It conducted formative evaluation, extensive consultations through curriculum writing workshops and meetings and several stages of field testing and revision in Nova Scotia and New Brunswick. In this context, the ASCP can be described as a truly "grass-roots", field-based curriculum project.

In anticipation of a published result, school jurisdictions in Nova Scotia held off making new textbook purchasing decisions for several years until the Atlantic Edition of **SciencePlus** became available. In the year prior to its appearance, it was formally tested by the Junior High Science Curriculum Committee of the Nova Scotia Provincial Department of Education. This committee recommended that **SciencePlus** be listed as a textbook series that local school boards in Nova Scotia could and which all ultimately did purchase for use in the schools.

At this same time, the Nova Scotia Provincial Department of Education's Junior High Science Curriculum Committee took the ASCP's research experience into account when it developed a new policy framework for junior high science. The result was a policy that matched field research and which was adequately supported by student and teacher textbook resources.

In New Brunswick, **SciencePlus** was one of four textbook resources tested by its Provincial Junior High School Science Advisory Committee. The objective was to adopt one of these resources for use in all schools. After three years of testing of each of the resources, the Committee recommended adoption of **SciencePlus**. A curriculum guide was then developed by the Committee based on **SciencePlus**.

There was a downside to the New Brunswick experience, however. With a commitment to fairness to all the publishing houses involved in the testing, the Province broke off all direct contact with the ASCP from 1985 until 1989. Instead, all discussions with the Province

related to **SciencePlus** and the competing texts had to be conducted by the publishers of the texts. In order that other publishers not cry foul, the ASCP was advised by HBJC to keep a low profile in the province. The result was that the link between formative evaluation and initial curriculum development, conducted with provincial department of education support from 1977 through 1984, and implementation, begun in 1989, was broken. This downside to the New Brunswick experience, however, has been partially compensated for since the decision was made to adopt **SciencePlus** by the conscientious work and cooperation of Department of Education personnel in helping to re-establish New Brunswick teachers' sense of ownership of the ASCP and **SciencePlus**.

The Atlantic Science Curriculum Project's experience in Ontario has been much more problematic and may be more typical of the relationship between curriculum planning and curriculum materials development. There was apparently extensive consultation with teachers by the Ontario Ministry of Education in developing the recently adopted guidelines for science in the intermediate grades (7-10). However, the development of textbook resources to support the guidelines was left as an independent task to be performed by publishers. The principal drawback to this procedure is that the curriculum plan, developed by the Ontario Ministry of Education in this case, was not itself tested. Rather, it has the status of law. Curriculum materials and teaching must conform to the plan. [AN]

It should also be noted that field testing of materials is not mandatory in Ontario and therefore much, if not most, of the school textbook material published in Ontario for use in Ontario schools (and elsewhere) is apparently not thoroughly field-tested. However, the Atlantic Science Curriculum Project has an operative agreement with its publisher that all material which it authors must go through extensive field testing before being published, normally including a developmental test in selected classrooms and after revision a further more extensive field test in a range of conditions. [AN]

The short period of time available for the development of three new units and one largely amended unit out of 12 units included in the two book Ontario Edition of **SciencePlus** meant a contraction of the usual procedure to one intensive field test for each of the new units. This was less problematic, however, than the necessity of conforming to a curriculum plan which in important

respects was known by the ASCP from prior developmental field testing to be less than completely workable in the classroom. For example, it does not appear feasible or realistic to expect teachers to guide grade eight students to meaningful learning of the usual conceptual content of a unit on work, energy and machines within the 16 hours alotted in Ontario to the teaching of this unit. However, when this content is broken into two units as in the Atlantic Edition of **SciencePlus**, one taught in grade seven and the other in grade eight, meaningful learning can take place.

A similar problem exists in connection with one or two of the life science units designed by the Ontario Ministry of Education for grades seven and eight. The attempt to include more material in a single unit than can be assimilated meaningfully by most students is perhaps a typical result of curriculum planning by committee. Noting, however, that the content of such units is usually repeated again in later grades it is clear that the problem for school curriculum is not principally a lack of time to teach things well, but a lack of coordinated planning of science curriculum from the elementary through the senior high school grades.

The separation of curriculum design, which does not get tested, and curriculum materials development, which may or may not include field testing, is a fundamental flaw in typical curriculum development procedures. Rather, curriculum materials development should not be conceived as the execution of curriculum design; **curriculum materials development and curriculum design are mutual tasks that should be united in curriculum development projects; both the design and the materials should be tested together.** This procedure would likely force policy makers to be more realistic when specifying required curriculum for schools. It should also lead policy makers to the practice of planning curriculum over a larger number of courses, since it would no longer be possible to compensate for lack of such planning by attempting to force excessive content into a single unit or course. [DF] [AN]

In contrast with the situation in Ontario, the Alberta Junior High Science Curriculum Committee appeared in 1987 to have an opportunity to link curriculum planning with curriculum development in connection with contract publishing. This at least was the aim of the educator subsequently engaged by Alberta Education as program manager for the development of its new junior high science curriculum. Apparently, however, political considerations ultimately led to a decision to contract

two competing publishers to develop curriculum materials. After competitive proposals from a number of publishers had been considered, Alberta Education selected Harcourt Brace Jovanovich, Canada and a joint endeavour between Wiley,Canada and Arnold Publishing from Edmonton.

In order to establish a fair competition between HBJC and Wiley/Arnold, a highly speculative modification of the ASCP's original curriculum design became a legal specification against which curriculum materials from both publishers were field tested. The design itself was graven in stone. However, the modified curriculum design appears to be so demanding that many teachers are likely to try to cope with it by rote teaching. Indeed, Wiley/Arnold have facilitated that kind of use of the material they developed by a traditional emphasis on definitions and narrative statements of content. [IS] [AM] [JT]

Even with a commitment to science concept teaching in a meaningful technologicial and social context, the problem for Alberta science teachers is this: No teacher that the ASCP has worked with has been able in the time available for junior high science to utilize meaningfully more than five of the ASCP's units in a school year. Nevertheless, the Alberta core curriculum specifies six such units each year and envisages additional locally developed units to be taught as well. Furthermore, several required units focus on technology. Because of the integrative nature of technological problem solving, which draws upon a wide variety of fields of knowledge, these units tend to be more time-demanding than the ASCP's previously developed ones. (See McFadden, 1990, for an account of the characteristics of such a unit). Teachers are caught between the proverbial rock and a hard place; either cover the curriculum largely be rote or cover no more than two-thirds of it with the objective of helping the students better understand the natural and human-made world.

Unfortunately, after initial discussions that promised a very different outcome, the ASCP found the door closed to any further direct discussions between the ASCP and Alberta Education with regard to the adequacies or otherwise of the curriculum design. Consistent with the priority of fairness to two competing publishers, the ASCP was treated by Alberta Education in relation to the curriculum design as hired hands of the publisher, the recipients of commands from Alberta Education via the publisher to conform to the

design. This is likely the inevitable result of the separation of curriculum design and curriculum materials development. Moreover, this circumstance probably favours the financial viability of the publisher managed text. When educators control the outcome, they tend to want to develop materials that support meaningful learning, rather than to develop dictionaries that accomodate covering a curriculum that proves to be too demanding for students and teachers. The solution to this problem appears to be in the hands of educational policy makers (and so, ultimately does the responsibility). [MD]

In a critical account of textbook publishing in the United States, Tyson-Bernstein (1988) has argued that "the source of the writing problems is not the publishing house, but in the public agency. Legislators, educational policymakers, and administrative regulators have unintentionally drained the life out of children's textbooks." (p.1) She further observes that "state agency policies, however well intentioned, have ... compelled most textbooks to cover more information than can be treated respectfully... The large ideas that make sense of scientific data have been sacrificed to make room for more parts and components." (p.9) Moreover, these agencies unintentionally "discourage publishers from investing the time and effort it takes to produce carefully written material by failing to buy from publishers who do produce well written textbooks." (p.22) Tyson-Bernstein concludes that "an effective reform effort depends on a full understanding of the economic and political realities of how textbooks are written, published and adopted." (p.38) Among other things, she recommends that educational policy makers cease the practice of issuing detailed, skill-oriented bid specifications to publishers. Instead she urges that they select books on the basis of qualities that are known to benefit students and reward the publishers that produce such books.

There were, nevertheless, some very positive benefits from the commitment that Alberta Education made to the development of a new science program. In particular, its commitment of substantial personnel resources to the critical review of manuscripts and the collection of extensive field test data proved very helpful to the ASCP and its developmental field test teachers in Alberta in their efforts to develop classroom worthy curriculum materials to support some novel and challenging unit designs and educational goals.

Rewards to authors. The question of suitable rewards for authors of curriculum materials was faced by the ASCP when several leading science educators in the United States encouraged the ASCP to develop editions of **SciencePlus** for the United States and tentatively offered to assist. Aside from the problem of finding a publisher to support such an initiative, the ASCP was also faced with the problem of whether there would be sufficient rewards for prospective new authors to attract them to enter into collaboration with the ASCP. The principal needs of the ASCP's potential collaborators were a reasonable prospect for professional recognition and funding for time-off from teaching responsibilities.

The experience of the original group of ASCP authors could not provide a model for how to attract new authors. The original authors had neither funded time-off from other responsibilities to develop SciencePlus nor, during the period when most of their work was done, a reasonable prospect of professional recognition, where reasonable recognition is equated to that given for activities (primarily research and administration) that they would otherwise have been engaged in. Instead, their involvement is probably better explained as the result of many small commitments over many years, leading to an involvement that went well beyond any they ever intended.

This circumstance posed quite a dilemma. New authors could not be expected to make up-front commitments that went beyond any the initial authors had consciously made. The response of our U.S. colleagues was to seek U.S. National Science Foundation support for their involvement in a collaborative effort with the ASCP. Regrettably, the National Science Foundation was unwilling to support a project that was seen by it to be largely initiated from another country. [AD]

The alternative of a publisher-supported project in the United States remains. However, the example of traditional publisher initiated or supported projects is likely misleading to new authors who might want to collaborate with the ASCP. The time demands made of writers engaged by publishers in the traditional publisher initiated textbook writing projects are small compared to the demands on the participants in a project which aims to support meaningful learning in science. The former can be managed by working evenings, weekends and summer vacations. The latter cannot. Moreover, the usual royalty rewards may more closely approach a reasonable return for the time in

the former case, compensating for the additional income that might have otherwise been earned through overload teaching, administrative jobs or consulting. However, in the latter case, even in the larger United States market, there can be no reasonable expectation for financial compensation for the minimum of one year of professional effort required in the development of each new ASCP unit. Furthermore, new authors might expect to spend more than this amount of time initially developing units that matched in pedagogical characteristics those originally developed by the ASCP.

The Atlantic Science Curriculum Project has only been able to complete its tasks because of the participation as principal authors of a couple of now retired teachers and several university and college teachers. The latter have commited several years of their research and sabbatical leave time to Project related research, writing and administration. Two of these were already tenured full professors and therefore perhaps less concerned about whether professional recognition for their efforts would be sufficient to merit their involvement, whereas two others simply ignored this concern and survived. The remaining authors, who had full time school teaching or consulting jobs, experienced the greatest personal pain as authors, completing their work under nearly untenable conditions, including repeated interruptions in their writing efforts.

This experience probably does not provide a solution to the problem of engaging new authors to collaborate with the original ones. Moreover, it probably does not (at least so far) provide an example that would stimulate similar initiatives by other groups of educators. On the other hand, the principal authors and apparently also at least a large proportion, if not indeed all, of the scores of talented teachers, researchers, administrators, editors, illustrators, secretaries, consultants, teacher educators and others who have contributed to the Atlantic Science Curriculum Project have derived personal satisfaction from their involvement that may transcend the absence of more tangible rewards.

If it seems to the reader that the evident personal benefits are still too few to stimulate similar curriculum development initiatives by individuals, there are reasonable alternatives. Serious curriculum development can be a significant form of educational research and could be given recognition as such, particularly if educational researchers could begin to

see that many of their tasks are more analogous to those of technological than to scientific research. (In the former, the objective might be to build a better mousetrap rather than to understand the psychology of the mouse.) Recognition of serious, experimental curriculum development as important research could make it more tenable for university faculty members, including younger, untenured ones, to participate in curriculum development projects. For this to happen, however, there is a need for a curriculum materials evaluation procedure that would be professionally equivalent to the peer review process that takes place in the case of refereed journal articles.

Furthermore, educational policy making bodies could employ their consultants not only to draft policy statements, but also to work on the translation of these statements into curriculum materials. This latter commitment would help to bridge the unfortunate separation that presently exists between curriculum planning and curriculum materials development.

On the other hand, the participation of school teachers and consultants as authors requires paid leave time for that purpose, either externally funded or covered by the employer. No school teacher or consultant should be expected to undertake the kind of work required of authors by a reform-minded curriculum development project while at the same time carrying a full time school teaching or administrative responsibility.

Given that the materials developed by the ASCP would not likely have been as successful in the classroom without the participation of school personnel in the Project as authors, the ASCP was fortunate to have three people willing to make the personal sacrifice. Perhaps other projects can solve this dilemma more humanely by securing support for paid leave time for school personnel who participate as authors.

In the following, final part of this paper, by way of conclusion, a strategy is proposed for a reform-minded curriculum development project. It is a strategy that can be pursued on a local or regional basis by volunteers, without necessarily having any initial funding.

Comments on Part III

Truman Layton (Teacher, Contributing Author to a textbook series and former Science Consultant for the Nova Scotia Department of Education): As an Author, in practice, I have no rights at all. The editor...and her henchman...make all the decisions and the president of the company has told me that that is the way it is. If I don't like it I can get out of the writing process! He told me his expertise is in producing books that make money and that is his job and what he is going to do. If you have seen [a certain elementary science textbook series - CM] you will know why I hope he is wrong.

Michael Davis (Vice President, Irwin Publishing; former Atlantic Regional Representative, Academic Press/HBJ Canada): I leave the scene [of the Atlantic Science Curriculum Project - CM] here and any comment would only be speculation on my part. I should suggest however that the ensuing "publisher wars" probably point out the reality of project - publisher relationships. Publishers are responsible to their owners and/or shareholders for the bottom line. Consequently they need to be in control of what they are spending their money on. The U.S. foundation model is such that the publisher is in a position to take or leave an innovative project but without the control. The caveat is that the project have sources of income other than from commercial publishers.

David Francis (Lanark House Communications, Toronto; former Senior Editor, Harcourt Brace Jovanovich,Canada): You say that HBJC merged with Holt. As far as I know, they are legally two separate companies but they share a common management. When HBJ acquired Holt in the U.S., it was required by Investment Canada regulations to divest itself of Holt's Canadian subsidiary. HBJ did this by selling it to the management of its Canadian subsidiary, HBJC--a de facto merger, I suppose.

Michael Davis: We took a longer range view because we saw possibilities for:
a) Wider markets and
b) regional adoptions or editions.
To a degree, however, we did buy the model for this other development. But above all we recognized that the primacy of provincial curriculum would shape content, hopefully without compromising the innovative features of the program. In that sense we were "realistic believers".

David Francis: As far as the publishing side of the process is concerned, you are quite correct in recognizing the limitations which commercial considerations place on the publisher's role. Ultimately, the problem for a curriculum project such as ASCP is that the more money a publisher contributes to its development, the more the publisher will want to call the tune. This means that publisher relations will inevitably be a problem for a curriculum development team that wants to preserve its independence.

HBJ's initial involvement in the project cannot be taken too far as a model for such relations because it was very much a product of special circumstances. As the prime advocate of the project when we first became involved, my interest was opportunistic--it was a chance to acquire quality materials in an advanced state of development that would quickly establish us as a presence in the junior high science market. Both Paul [Paquette - CM] and I anticipated that relations with the project team would not be simple and that the team would be much more protective of its prerogatives than most educational authors would be. However, we felt that the value of the materials and their significance for our list justified any additional complexity in dealing with authors and that, in the final analysis, the common interest of HBJ and ASCP in the effective dissemination of the materials would override any differences and make compromise possible. Of course, with the change of management, these special circumstances ceased to exist, and you were suddenly faced with a publisher who had a decidedly more conservative view of the situation.

Barring such unusual (and perhaps because of that, unstable) situations, I think it will be very difficult to find a publisher willing to devote large resources to a curriculum project without the certainty of an equally large measure of control over the end product. It might be possible to enlist the support of some small, specialized publishers or university presses, whose goals and thinking would be compatible with those of the project team, but these organizations would not have the financial capacity to give any significant support to the project.

It would also help if publishers were to adopt a much longer, Japanese-style perspective with regard to return on development investment, but the priority given to short-term measures of performance and (often legitimate) cash-flow requirements make such a development unlikely.

It seems to me, therefore, that all this rules out the publisher as a significant backer of a curriculum

project. They are likely to be very unenthusiastic about leading curriculum change. However, if the project team has developed materials that have strong commercial possibilities, this will give them some leverage in negotiating a more favourable deal with the publishing house.

David Francis: You hit the nail right on the head when you say that educators who make curriculum policy and textbook adoption decisions are largely responsible for the situation in which "managed texts" dominate the market.

Anonymous publishing executive: More precisely, [in Ontario - CM] texts must be listed on Circular 14. In order to be listed they must meet 80% of the curriculum objectives.

Anonymous publishing executive: I don't know of any province in which it [field testing - CM] is mandatory.

David Francis: You recommend that curriculum materials development be linked with curriculum design. I can see the logic of your argument, but would this not also create a situation in which teachers and students were limited to a single set of materials? The one advantage of the Ontario system is that it does offer a choice of materials, thus allowing the possibility of matching materials to different learning and teaching styles.

Anonymous publishing executive: A trend which you may not be aware of is "multiple listing". Instead of a province listing only one program they will list two or three. This is a national trend with ramifications for all subject areas. This makes it difficult for a collaborative effort between curriculum development and materials development.

Ian Strachan (Teacher, Robert Warren School, Calgary and Developmental Consultant, ASCP): I particularly liked your statement that curriculum design and materials should be tested together. I have heard a lot of teachers voicing concerns over the fact that this was not done to the extent that they thought it should be in Alberta. Now that we are in the middle of the new curriculum some teachers are wondering if it is appropriate for the skills at that grade level. Many of us are also wondering how we will be able to finish and cover the material in the way it should be covered before June.

Alan Moore (Professor, Nova Scotia Teachers College and Principal Author, ASCP): I would leave it to others to judge Wiley's effort.

Jeff Turner (Teacher, Sherwood Community School, Calgary and Developmental Consultant, ASCP): As far as working as a consultant with ASCP [on the Alberta Edition], I encountered two problems. It took me almost a full year to understand the philosophy behind the structure of **SciencePlus**....The second problem that arose was trying to give input on what Alberta Education guidelines wanted and trying to match them to the framework of **SciencePlus**. I found this very frustrating. I wasn't comfortable with what Alberta Ed. defined as STS and how to fit this idea in with the nature of science....The next time ASCP is in this situation...there is a need to sit down and review in detail the philosophy of ASCP with all new members at the start...Teach the teacher how to use the book. Here in Alberta teachers do not know how to use a textbook, so they tend to sit on the shelf collecting dust. The type of inservicing in Nova Scotia is what we need out here.

Michael Davis: It is true that provincial curriculum departments, for the most part, like to deal with publishers rather than author teams or cooperative projects. The former relationships are established, the ground rules are known and provinces clearly hold the upper hand. As part of your model you might consider ways for a group of reformers to become resource people for provinces with the outcomes (possibly student materials) being offered to publishers...

Al DeVito (Professor Emeritus, Purdue University, author of several books for science teachers): You never spelled out completely your expectations from us relative to the reward system. Americans, not unlike the rest of the world, want to know "What's in it for me (us)?" Granted you and your group donated an inordinate amount of time and effort. This project is and was your creation. People work in direct proportion to their role in developing an emerging, creative project. This project is your baby. We do the same thing here. In fact we did. The new UNESCO SOURCEBOOK was written at Purdue with donated efforts from a host of U.S. science educators. I was never sure what you expected from us in terms of effort and how it might mesh with your efforts.

You assembled a fine group of U.S. science educators, each with a track record of success. That's

good! But it can also be bad. All have established vitas. They are not hungry for opportunities to climb the academic ladder. They are a tremendous group of individuals, likeable, etc, but I had trouble picking out the heavy horses that would pull the load.

...It is difficult to re-write another person's efforts and keep the lines of credits clear. How can you assign credits or responsibilities for partial repairs or changes?

Part IV. A Strategy for Curriculum Development in the Context of an Educational Reform

Taking into account the stakeholders in curriculum change and their interests, the first question of strategy is who to involve in the team which initiates a curriculum development project. Tyler (1975) recommended a deliberative approach to curriculum development involving teachers, subject matter specialists, curriculum specialists, psychologists, sociologists and specialists in human development. In a similar vein, Pratt (1980) proposed that the ideal curriculum team would include those with special competence in subject matter, pedagogy, curriculum design, measurement, organization and writing.

Of course, getting the right people together for the task of curriculum development is not by itself a guarantee of a successful endeavour. Barrow (1984), for example, has emphasized the individual classroom teacher's role in curriculum decisions. Stenhouse (1980) has pointed to the centrality of professional development in efforts to reform curriculum. Zais (1976), among others, has contrasted the shortcomings of administrative approaches to curriculum development with some of the strengths of grass-roots models of curriculum development and Schwab (1969) has argued against an overly theoretical approach to curriculum change and for greater attention to "the practical". The Atlantic Science Curriculum Project's experience has also illustrated the critical role played by the relationships between authors, policy makers and publishers. It is reasonable to conclude from such arguments and experiences that not only the inclusion of the essential participants in curriculum development but also the way they work together is critical to the prospects for success of a movement for curriculum reform, particularly if at issue is a fundamental change in the educational system.

Before suggesting specific details of a strategy for a curriculum development project that aims to contribute to fundamental curriculum reform, including who should be involved and how, it might be useful to be reminded of the more usual approaches to curriculum development. Most often those involved in curriculum change work independently. The policy makers produce curriculum designs (a process which is frequently equated to curriculum development). Commercial publishers develop curriculum materials, employing writers to draft the materials and editors to finalize them. Teachers attempt to utilize the schematic prescriptions, manuals

and dictionaries of knowledge that emerge from this process. Students attempt to get something out of the resulting school experience. Educational researchers study and comment on the process. Educational psychologists and instructional methodologists work with pre-service and in-service teachers in the hopes that they will be able to amend the textbook curriculum so that schooling might be of some benefit beyond fact-recall to students. University subject matter specialists assist teachers with the objective that knowledgeable and creative scholars might still emerge from schools and parents attempt to influence the process with the hope that their children's success in school (usually equated to their grades) might be a route to their economic independence.

An exception to this more common process of curriculum development is the federally, provincially or privately funded curriculum project, which often, nevertheless, remains characterized by an absence of collaboration between all of the essential parties to curriculum change. Here the initiative is taken by the funding agency and followed by the party that is qualified to obtain the funding under the terms of the agency's regulations. Although no fundamental change from an information dispensing educational system has yet taken place as a result of such initiatives, some of these projects, arguably, may have made a contribution towards that evenutual end. [TL]

Stage 1. Informal curriculum development

The proposed strategy for contributing to fundamental curriculum change by means of a locally or regionally initiated curriculum development project is summarized in Figure 4 and a brief chronology of the Atlantic Science Curriculum Project is given in Figure 5. The first stage in the proposed strategy is informal curriculum development, where the emphasis is on formative evaluation and curriculum experimentation. At this stage curriculum design is considered problematic, that is subject to experimentation.

This stage occupied the first several years of the Atlantic Science Curriculum Project's endeavours to improve junior secondary science curriculum and teaching in the Canadian Maritimes (1976-1980). It is more typically, however, either omitted altogether or severely truncated in other curriculum development projects, which usually are initiated by a publishing contract or a contract with a funding agency to develop materials which conform to a predetermined curriculum

FIGURE 4. STRATEGY FOR A CURRICULUM DEVELOPMENT PROJECT

STRUCTURE	TASKS
Stage 1. Informal Teachers Consultants Educational researchers Subject matter specialists	**Research** 1. Formative evaluation = consultation with teachers 2. Drafts of experimental materials 3. Informal testing in a variety of situations
Stage 2. Formal Advisory Panel Project Director Author-in-Chief Authors Developmental Field Test Teachers	**Curriculum Materials Development** 1. Development of materials including developmental field testing 2. Institutional affiliation 3. Contractual relationship with a commercial publisher 4. Extended field testing and revision 5. Publication
Stage 3. A Continuously Functioning Project Advisory Panel Board of Directors = Principal Authors + Principal Consultants	**Continuing Professional and Curriculum Development** 1. Formation of a network of the users of the published materials 2. Continuing professional development linked with continuing research and curriculum development, including revision of published materials

FIGURE 5. BRIEF CHRONOLOGY OF THE ATLANTIC SCIENCE CURRICULUM PROJECT

1976 - 1984 "Grassroots", field-based curriculum development project in Nova Scotia and New Brunswick for science in grades 7 - 9

1976 Survey Consultation of teachers and principals (Formative evaluation)

1977-79 Marriage of curriculum writing and professional development (through University and government sponsored curriculum writing workshops)

1980-84 Writing and developmental field tests of curriculum materials (Supported by the teaching profession and universities in Nova Scotia and New Brunswick)

1984 - 1988 Publisher supported development and publication of the Atlantic Edition of SciencePlus (for grades 7 - 9)

1984-1986 Field-test development and publication of SP1

1985-1987 Field-test development and publication of SP2

1986-1988 Field-test development and publication of SP3

1986 - Collaboration with educators in other jurisdictions to develop further editions of SciencePlus

1986-1988 Development of an Ontario edition for grades 7 & 8

1986-1989 Development of French language versions of the Atlantic and Ontario editions

1987-1990 Development of Science Plus Techology and Society for Alberta grades 7, 8, 9 (an STS curriculum based on SciencePlus)

1990 - Research and development of an articulated science - technology - health - industrial arts - home economics curriculum for grades 7 - 9

plan.

The initiative which led to the Atlantic Science Curriculum Project came from reform-minded science educators who combined experience in scientific research, educational research, school level science teaching and teacher education. The initiative for embarking on a curriculum reform project could, of course, come from other segments of the community, such as scientists, teachers or businesspeople. It was probably beneficial to the long-term prospects of a successful reform of curriculum, however, that the ASCP was initiated by persons who each had broad professional experience and contacts with all segments of the community that play essential roles in curriculum change. It was not as difficult for them as it might be for others with a more restricted professional background and experience to recognize and bring together all the essential partners in a curriculum reform endeavour.

Whoever takes the initiative, the team which is brought together for the informal stage of curriculum development should include each of the following:

(1) **Educational researchers and subject matter specialists.** Those who possess knowledge of the frontiers of science and pedagogy are essential if an educational project is to aim, as it should, to advance curriculum in a given area. The participation of scholars in the subject areas of the curriculum helps to ensure that the school curriculum remains abreast of advances in knowledge while the participation of educational researchers helps achieve a pedagogical approach consistent with research on teaching and learning. At the outset of the Atlantic Science Curriculum Project, research experience in each of biology, chemistry, engineering, geology and physics as well as in education was represented. The two principal initiators of the Project combined recent research experience in science (spanning chemistry, geology, physics and engineering), recent school teaching experience, an interest in the history and philosophy of science and current participation in educational research. Other leaders in the project had extensive school teaching experience, bachelor's or master's level degrees in science and bachelor's to doctoral level degrees in education with corresponding levels of experience in educational research. The major shortfall in the team which initiated and led the ASCP was the absence of continuing participation in the Project of anyone who combined research level experience in both biology and education. This

shortcoming required numerous compensatory efforts, including unit reviews by research scientists working in the areas of biology addressed by the units. As much as possible, those wishing to initiate a curriculum development project aimed at fundamental reform should endeavour to find long-range collaborators who together combine research experience in all the subject matter areas to be addressed by the curriculum materials and significant educational research experience. Indeed, it would likely enhance the project's possibilities of making a worthwhile contribution to educational reform if each of the principal leaders of the project had a research level of expertise in both subject matter and pedagogy.

(2) **Consultants.** Curriculum consultants employed by the educational policy making bodies in the region (for example, provincial departments of education and school boards) should be included in the project with the objective of ultimately linking educational policy making and curriculum development. It is important, however, that the basis for such participation at the initial, informal stage not be the short term concerns which may occupy the policy bodies. A curriculum development project which aims to contribute to fundamental educational reform cannot be a short term project. In the case of the Atlantic Science Curriculum Project, the science curriculum consultants for the Provinces of Nova Scotia and New Brunswick both participated in the leadership during the early stages of the Project. Also, the science consultant for the Halifax City School Board has been a continuing leader of the ASCP from the outset.

(3) **Teachers.** The initiative in a curriculum development project might very well come from highly motivated, suitably qualified classroom teachers. The time demand for orchestrating fundamental curriculum change, however, is probably beyond that which a person could meet while maintaining a full school teaching load. The author, for example, was compelled by this challenge to give up a half time school teaching load in favor of full time employment at the Atlantic Insititute of Education, which supported the initiation of the ASCP. In general, the participation of classroom teachers with research qualifications and experience in the leadership of a curriculum reform project can be facilitated by their employment in university Faculties of Education, where they might fulfil their university scholarly responsibilities through curriculum research and development and where some of their teaching load might include courses designed for teacher professional development.

Recommendation 1. Educators interested in contributing to a reform of the educational system through a curriculum development project should initiate such a project as a collaboration of teachers, consultants, educational researchers and subject matter specialists.

The first task of an informally constituted curriculum development project should be formative evaluation featuring a survey consultation with the teachers. This formative evaluation might also include such research activities as textbook analysis, classroom based interpretive research, education policy studies and historical research on curriculum and teaching. The survey consultation with teachers might endeavour to find out the circumstances in which teaching is currently taking place (for example, teaching loads and schedules, facilities and equipment), the background experience and education of the teachers, their teaching goals and practices, their views on current curriculum and curriculum materials and their preparedness to participate in a curriculum reform project. The results of such a consultation should, of course, be shared and discussed with the teachers. In the case of the Atlantic Science Curriculum Project, the results of the survey consultation were first shared with the teachers and then publicly reported in articles by two of the Project's leaders (Morrison, 1978; McFadden, 1980). [SV]

Remembering that curriculum development is above all else a matter of professional development, opportunities for curriculum discussion, planning and writing by teachers should be included as part of a curriculum reform project. Such workshops can help to shape the project and may attract teachers who may ultimately be able to contribute to the writing of publishable quality materials or serve as consultants.

The Atlantic Science Curriculum Project conducted graduate level curriculum writing courses at five universities in New Brunswick and Nova Scotia. Nearly one hundred Nova Scotia teachers and more than twenty from New Brunswick participated during the initial informal stage of the ASCP. Those from Nova Scotia included nearly one of every four junior high science teachers in the province. [JM]

The curriculum materials developed in the ASCP workshops included guide materials for teachers, but seldom went beyond accompanying activity worksheets for students. Materials at this stage of development were nevertheless informally tested in classrooms by

hundreds of teachers in Nova Scotia and New Brunswick and indeed became the primary curriculum resource for many teachers and several schools until **SciencePlus** was published.

Stimulated by what proved to be a premature publishing contract, the curriculum writing workshops were followed by an attempt to engage the most successful of the workshop participants in writing materials for students. The specifications that were given by the project leaders for these materials were very demanding and the opportunities for contributing writers to collaborate on the writing of the materials were few. On the whole, this early effort was unsuccessful. Only one of twenty teachers engaged at this stage was ultimately able to find the time and opportunities for the research, collaborative planning and writing that turned out to be required to develop the kind of student materials and teachers' resources that were wanted.

Regrettably, most of the Project's initiators were unwilling to take writing responsibility at this point. Many of them did, however, ultimately join in taking on the major share of this responsibility. The very competent teachers assembled for the project by its initiators and ultimately scores of other very able teachers served as developmental field test teachers and guided the many revisions of the materials.

It is evident in hindsight that a curriculum project attempting to develop materials that serve educational goals that go beyond the recall of information needs to take into account the demands this task will make on authors. The leaders of the ASCP, reflecting also the wishes of the teachers, wanted interactive, engaging materials for students, materials that corresponded to students' cognitive abilities and interests, that were written as well as the best of trade books for youth and better than existing curriculum materials dealing with the same topics for the same age range, that included learning activities designed to elicit students' existing ideas and to facilitate the accomodation and assimilation by them of new concepts, that could be used by teachers in a wide range of teaching circumstances, including the absence of laboratories and a consumable materials budget, but would nevertheless incorporate hands-on, minds-on learning activities for a third of classroom time, that could be organized in magazine format on double page spreads so that individual learning activities would not extend beyond an open double page. Such materials

were bound to require more time and imagination than the narrative recounting of adult knowledge.

Nearly all of the first drafts of materials, including those by the ultimate principal authors, could only be characterized as narrative accounts of science. They invariably fell well short of the specifications that all had agreed to. In fact, most initial drafts were almost, but not quite as bad as typical textbook material, making it very easy to understand how typical textbook prose is written, even by otherwise intelligent people whose own teaching is much more imaginative than their writing.

The ASCP's early difficulties in identifying authors and helping them get on track may prove to be the rule rather than the exception for curriculum development projects that genuinely aim to contribute to educational reform. Certainly, those who tie themselves into early time commitments to produce materials do so at their own peril. They may not do much better than contribute to the textbook pollution that students and teachers are already forced to endure. It is also worth recognizing the value, if not indeed the necessity, of a period of experimentation to resolve fundamental questions about the overall structure and content of a curriculum. Otherwise, the resulting curriculum specifications and curriculum materials might ultimately not correspond very well to teaching and learning in classrooms. [MS]

Recommendation 2. Curriculum development projects should include a suitably lengthy informal stage, one without time limited contracts and obligations to produce curriculum plans and materials. This stage should be used for formative evaluation, professional development and experimental curriculum design and supporting materials development, including classroom testing.

Stage II. Formal curriculum development

Whereas the first stage of a curriculum development project is informal, characterized by the absence of formal obligations, except perhaps to agencies which have funded the project's formative evaluation and curriculum experimentation, the second stage in this proposed curriculum development strategy is charactarized by a formal commitment to develop curriculum materials. In this connection the following questions are addressed below. 1. What should be the structure of the curriculum development project at this

stage? 2. What are the preferred forms of relationships between the curriculum development project and (i) educational jurisdictions and (ii) commercial publishers?

At a time that corresponded roughly to the second stage proposed here, the Atlantic Science Curriculum Project's formal structure included a Project Director, an Author-in-Chief and a group of Principal Authors, together constituting an editorial board. In effect, those who had participated in the informal stage of the ASCP either became principal authors or for the most part dropped out of formal participation in the Project's editorial meetings. Less formally, however, the ASCP at this stage included advisors of various sorts, consultants on editorial matters, a large group of developmental field test teachers, research assistants and secretaries.

None of the work of the more formally attached participants in the ASCP and very little of the less formal support was ever directly funded. The direct funding of the Project has been under one hundred thousand (current value) dollars, whereas the estimated current value of the contribution of the principal author group has now nearly reached two million dollars and that of the supporting cast another half million dollars. The publisher estimates its direct financial expenditure associated with field testing, editing, photo research and illustration of the several editions of **SciencePlus** to approach another two million dollars. In sum, nearly five million dollars would be required at this time to purchase all the services that were engaged in this second stage of project development.

With regard to the division of labour between the ASCP's principal contributors, the Project Director was responsible for holding the team together, including the formal and informal participants, for relationships with the publisher and for overall project leadership. The Author-in-Chief was responsible for pedagogical consistency, including doing pedagogical editing of all the units. And each unit which the ASCP developed had a Principal Author, who usually was the person who had done the first successful draft and who subsequently was given the ultimate responsibility for the unit. The complete process of unit development is represented in Figure 6.

In connection with the six new and two largely revised units for the Alberta Editon, the Project formally engaged developmental field test consultants.

FIGURE 6. UNIT DEVELOPMENT PROCESS

Action		Persons Involved
STAGE 1	Initial Unit Design	Project Director Principal Author
	Purpose: Each unit should fit within an articulated program that addresses all the intended content and process goals.	
	Curriculum Research	Principal Author
	Purposes: The new unit should match in quality of teaching ideas any existing curriculum unit on the same topic. Its scientific content should be consistent with contemporary scientific knowledge.	
STAGE 2	1st Draft Manuscript * Student text * Teachers guide & resources	Principal Author
	Purpose: The first draft should provide a complete resource for teaching and learning which achieves the objectives of the unit.	
STAGE 3	Developmental Field Test	Developmental Consultant (and other developmental field test teachers)
	Purpose: Major shortcomings and problems with the first draft should be identified and possible solutions suggested.	
	External Review	Content & pedagogical specialists
	Purposes: Reviews by scientists should help to ensure that the scientific content is significant and contemporary. The advice of leading educational researchers and curriculum thinkers should assist the authors in developing educationally worthy material.	
STAGE 4	2nd Draft Manuscript	Principal Author
	Purpose: The second draft should be successful in a range of classrooms and with students of varying ability and interest in science.	
STAGE 5	Pedagogical Editing	Project Author-in Chief
	Purposes: The unit should blend in with units written by other authors, matching them in quality and style. Problems with the continuity and flow should be addressed.	

STAGE 6	Field testing	Field test teachers

Purpose: The curriculum resource should support successful teaching and learning in a wide variety of classrooms and with a wide variety of students, matching the range of teacher, student and school characteristics that exists within the educational jurisdictions that will be using the resource.

Stage 7	3rd Draft Manuscript	Principal Author

Purpose: The manuscript submitted for publication should successfully resolve all the problems which have been identified through field testing and review.

STAGE 8	Copy editing, lay out photo research and illustration	Publisher (with corrections and approval given by the author)

Purpose: Lay-out, photos and illustration should support the author's instructional intent and facilitate student and teacher use of the unit.

Previously, many teachers had performed similar roles, but these roles were never formalized. Essentially, a developmental field test consultant is an exemplary teacher selected by the principal authors to test the first draft of a unit and advise on its revision before the unit goes to more extensive field testing in a variety of classroom situations.

The ASCP also had the voluntary assistance of several people who provided advice to the authors. One of these made such a significant contribution that his participation was given prominent billing by the authors in the published works. Again, the relationship with such consultants was never formalized.

The Project might have benefitted considerably if it had been able to constitute a formal advisory panel. Lack of funding for the travel costs of bringing an advisory panel together, however, prevented the formal constitution of such a body. If the ASCP had been able to formally constitute such a body, the advisory panel would have included in addition to the educational researchers whom it consulted frequently, representatives from the supporting teachers' professional organizations and the provincial departments of education in Nova Scotia and New Brunswick and specialists representing the various branches of science and technology with which the curriculum project was concerned, including biology, chemistry, earth science, engineering and physics. Nevertheless, the ASCP benefitted from the informal advice, assistance and support it received from all these parties, as acknowledged in the published curriculum materials (ASCP, 1976-1990).

Recommendation 3. After a sufficient period of informal activity, a curriculum development project should constitute itself formally, including an advisory panel, a project director, an author-in-chief, principal authors, consultants and developmental field test teachers as required.

Although the ASCP functioned independently, it worked closely with the provincial science curriculum consultants in Nova Scotia and New Brunswick during the more formal curriculum development stage of the Project. Although this relationship was interrupted for a couple of critical years in New Brunswick, it has been continuous in Nova Scotia even with the retirement and replacement in 1987 of the provincial science curriculum consultant who initially participated in the

Project leadership.

Ideally the relationship between a curriculum development project and the jurisdictions that ultimately use the materials it develops should be such that curriculum design and curriculum materials development can be joined in a single process, with the project and the educational jurisdiction each preserving the right to make independent decisions. For example, the educational jurisdiction might decide upon publication of the project's materials, as New Brunswick did, to conduct a competition between materials and for that purpose to suspend relations with the project while the competition is conducted.

The relationship between a curriculum development project and a jurisdiction like the Province of Ontario would undoubtedly be restricted by that Province's practice of developing curriculum plans and then inviting all willing publishers to develop conforming materials within a relatively short period of time. However, even in that case, the Province could take into account the results of the project's experimentation when formulating its plans and the project might thus be able to develop suitable materials that are both faithful to the Province's plans and its own research results. In any case, this strategy is now possible for the ASCP since it has initially developed a large number of units, which taken together address most of the subject material and goals that are commonly included in science curriculum in the early secondary grades. [TL]

On the other hand, educational reformers might be well advised to avoid involvement in contract publishing arrangements where a very short period of time is available for development of materials and/or the Province's specifications are graven in stone, not subject to being altered by the results of field testing. The exception would be when the contract specifications are largely based on the project's existing research, a reasonable amount of time exists for the new research and development required and there is agreement by the educational jurisdiction concerned to modify its specifications in the light of new field testing results, particularly with regard to the amount of content specified for a given unit and the number of units teachers are expected to cover in a given grade. [MS]

Perhaps the most critical relationship for a curriculum development project is the contractual arrangement

between it and a publisher. A logical first consideration is what a curriculum development project and a commercial publisher have to offer each other. A curriculum development project which has adopted a strategy like that proposed here would at this stage have conducted extensive research, including the first stage development of a curriculum design and supporting curriculum materials. The resulting materials would probably be realistic and welcomed by the teachers and students who have participated in this work. Most probably, this activity would have established a market for the publisher, the larger the better in relation to extracting the greatest amount of support possible from the publisher. The publisher can then be expected to support further, more extensive field testing and to provide copy editing, photo research, illustration and design. [MD]

In terms of contractual details, the main concern of the project should be to maintain copyright to the material it authors. Maintaining copyright is protection against having materials transformed so that they no longer serve well the goal of an educational reform. Unwillingness of a given publisher to permit copyright to remain with the author would likely indicate that the publisher in question would be a poor partner for a curriculum development project. [TL]

Attention should also be given to the rights and obligations given by a contract in connection with revised editions. In the case of the ASCP's contract with HBJC, the ASCP is obliged to revise the published work as requested by the publisher. Otherwise, the publisher is entitled to engage others of its own choosing.

In the case of the Alberta edition of **SciencePlus**, the ASCP undertook the development of the equivalent of more than an additional new student textbook and a new teachers' resource book, involving altogether a commitment of more than six person years of professional endeavour within a period of two years. Moreover, the contract between the publisher and Alberta Education apparently specifies slavish adherence to a highly speculative curriculum design even though the ASCP never formally committed itself to such adherence and in practice has, with the support of the publisher, exercised independent judgement throughout the process.

The ASCP's involvement in the Alberta Edition of **SciencePlus** probably went well beyond any envisioned

legally by a commitment to revise an originally published work. The ASCP's commitment to this was voluntary, reflecting its interest in working on the new units required by Alberta Education and its concern that the publisher enjoy a sufficient economic success to continue its support for the ASCP. Nevertheless, curriculum development projects might be wise to qualify any contractual commitment they make to revising new materials so that such agreement is clearly limited to modest revision of the materials authored and excludes new units, let alone any commitment to develop the equivalent of new books. [DF]

Another aspect of its contract with a publisher that might be a matter for attention by a curriculum development project is whether the assignment of the right to publish and sell the work should be restricted geographically. The ASCP retained the right to approve the conditions of any agreement for the publication of its work outside Canada, but not the right to initiate such an agreement. Fortunately, its publisher has agreed to permit it to initiate such an agreement, subject to approval of the financial terms, which primarily concern a splitting of any royalties. Other projects might be better advised to seek to retain publication rights outside the geographical region in which its initial publisher operates.

Finally, a curriculum development project might wish to consider the question of institutional affiliation before signing a contract with a commercial publisher. The alternative would be legal incorporation of the project. In favor of affiliation with a university over other public or private bodies is that institution's commitment to academic freedom and its support for research and teaching.

The Atlantic Science Curriculum Project has been affiliated with three different universities in succession (Atlantic Institute of Education, 1977-1982, Technical University of Nova Scotia, 1982-1984 and University of New Brunswick, 1984 on), following the changes in the Project Director's employment. All three institutions have been very agreeable about taking on the responsibility to represent the Project and each in its turn has provided extensive administrative, secretarial, financial accounting and legal support to the ASCP. The contract with Harcourt Brace Jovanovich, Canada was signed on behalf of the ASCP by the University of New Brunswick, which from the outset of the Project has been one of its principal supporters and which since the Fall of 1984 has been

its administrative centre.

Recommendation 4. The principles guiding the relationships between curriculum development projects, educational jurisdictions and publishers should include the formal independence of curriculum development projects and educational jurisdictions along with their informal cooperation, the retention of copyright ownership of curriculum materials by curriculum development projects, the right of the publisher to publish and sell the materials in a specified geographical area, and a qualified obligation of the authors to revise the work when requested by the publisher.

Recommendation 5. Prior to signing a contract with a commercial publisher or other agency, a curriculum development project should obtain an institutional affiliation, preferably with a public university which is willing to represent the Project in its dealings with the contracted partner.

Stage 3. A continuously functioning project

Many interested parties in several countries have argued for the establishment and funding of on-going curriculum development and research centres. For example in the United States, Havelock (1971) proposed national systems for coordinated research, development, dissemination and utilization of curriculum. In Canada, the Ontario Royal Commission on Book Publishing (1973) recommended that the Ontario Ministry of Education seek through the Council of Ministers the cooperation of the provinces in establishing a national office of educational research that would fund the research and development of Canadian classroom books. In the U.K., Stenhouse (1980) argued for permanent agencies for curriculum development as opposed to projects which are discontinued shortly after materials are produced.

The strategy for curriculum development proposed in this paper is one that should lead to the establishment of a continuously functioning curriculum project. The third stage of the proposed strategy is characterized by an initial shift in focus from curriculum materials development back again to teacher professional development and other forms of support for curriculum implementation.

In the case of the Atlantic Science Curriculum Project, the publication of its initial work was staggered over

three years and was accompanied by the development of two further editions of **SciencePlus**. In addition to the material needed for the Atlantic Edition, further units were required for the Ontario and Alberta Editions. This circumstance has two causes that may not be operative in other curriculum development projects: (1) the size of the market for the Atlantic Edition, initially restricted to Nova Scotia, was not by itself large enough to cover the publisher's relatively heavy investment and (2) Canadian provinces actively exercise their jurisdiction over education to the effect that the organizational structure of schools and the content of school curriculum, particularly in the intermediate grades (6-10), varies greatly from province to province.

The result is that the Atlantic Science Curriculum Project has developed the equivalent of 30 units, 10 more than included initially in its original work. These have been published in three distinct English language editions, one French language companion version to the Ontario Edition and two distinct French language editions for the Atlantic Provinces.

Not until the spring of 1990, nearly four years after the publication of its first book, has the ASCP been able to begin focussing its attention on establishing a network of the teachers using its published materials, conducting a survey and field research on the use of the materials and, in general, linking continuing professional development with continuing research and curriculum development. Present projections are for this process to be well established no sooner than the end of the 1990-91 school year, in reasonable time to support New Brunswick teachers but rather late for the Nova Scotians.

The ASCP is also now the recipient of a substantial share of the royalties earned from the publication and sale of the materials it developed. For the purpose of disbursing these royalties to the various Project tasks and, in general, giving continuing leadership to the Project, the formal structure of the ASCP now comprises a Board of Directors, including the principal authors as voting members, and developmental field test consultants from outside the Maritimes as non-voting corresponding members. The Project Director is now Chairman and the Author-in-Chief, Treasurer.

Recommendation 6. Upon publication of their initial work, reform-minded curriculum development projects should constitute themselves as continuously

functioning curriculum projects, including the formation of a network of the users of the published materials and featuring ongoing professional development, research and curriculum development. [MS]

The earlier stages of the proposed strategy for a curriculum project are probably necessary to make this final stage possible. Shortcuts may be possible, but are unlikely. On the other hand, those who are serious about educational reform should be prepared to follow a path like that proposed. If the objective of a curriculum development project is to contribute to a fundamental reform of the educational system, as described in the first part of this paper, rather than the perpetuation, albeit inadvertently, of an information dispensing educational paradigm, the concluding recommendation may be the critical one.

Whatever contribution the Atlantic Science Curriculum Project may make towards the objective of a transformation of the educational system from a focus on information dispensing to a focus on truly educative tasks, far more remains to be done by others, not only in science teaching, but across the entire school curriculum. If others can learn something from its experience and will pick up the torch of educational reform and carry it forward, the Atlantic Science Curriculum Project will not have been in vain.

Comments on Part IV

Truman Layton (Teacher and former Science Consultant, Nova Scotia Department of Education): In my opinion, CHEM Study, PSSC Physics, BSCS Biology and Nuffield were not "information dispensing" intentionally. I believe that they were onto something important in their approach but they included too much information at too high a level. My suspicion is that these projects had too high powered specialists in the discipline who believed that all you need do is tell students something and they will understand it.

Surjit Verma (Curriculum Supervisor, Halifax County, NS): Before any curriculum development project begins, it may be a good idea for the curriculum teams to go into the classrooms and evaluate formally the status of science education.... A plan may then be formulated to bring about change.

John MacLennan (Teacher, Dartmouth, Nova Scotia): As I read your draft my thoughts went back to the courses at the AIE [Atlantic Institute of Education - CM] and to other courses I took from John Haysom [Saint Mary's University - CM] and others which were forerunners of units developed for the ASCP. You are right! It is a long haul and it did invove the input of a lot of people. (I find the ratio of one in four N.S. teachers incredible!) But, it is a "grassroots" project and by making it so it is more meaningful.

Having taught using **SciencePlus** texts for the past four years I can say that the material is more meaningful, relevant and appropriate for our students than any textbooks I have used before. I think I have become a better teacher because of these books and the inservices I have attended which went along with the topics in the texts.

Muriel Smyth (Teacher, retired, Fairview Junior High School and Principal Author, ASCP): The early years of our efforts were valuable in that they gave us time to develop material without the constraints and pressures that obtained once a publisher became involved....These "formative" years now seem to have been so important...

Truman Layton: The cooperation between a project and the users is essential. Somehow the dependence of Ontario on commercial publishers has to be broken if any worthwhile change is to be brought about. Do they have a strong political lobby?

Muriel Smyth: I feel that energy and enthusiasm for the

project could well have been dampened, and drained, if we had begun writing units under these conditions [the Alberta Edition - CM] during our earlier years....I think a group needs to develop its strengths and confidence over a period of time first, before undertaking that kind of assignment. Although I learned a lot from the experience in Alberta, it is not one I would readily repeat.

Michael Davis (Vice President, Irwin Publishing): For a cooperative project to work well it needs funding from other sources, preferably not stockholders. Then the publisher can play the role I think you envisage for it, namely to provide copy editorial and production expertise and yes even marketting. Alternatively you need to accept tension as a way of life if the publisher has an early financial stake. I'd opt for the first alternative.

Truman Layton: Maintaining copyright is all important!!!

David Francis (Lanark House Communications): The clause you suggest regarding [limiting - CM] the commitment to revise new materials might be a difficult one to negotiate with most publishers, who will want to get the materials into as many markets as possible.

Muriel Smyth: Your "Recommendation 6" includes "the formation of a network of users". Such a network should appeal to teachers who want a voice in determining the future of science teaching in the classroom. Educational leaves of several months are now becoming possible, at least around here, which will give teachers more opportunity to take an active part in curriculum development. It would have helped those of us who began in 1976.

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